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ABSTRACT

This report is part of a 4-year study of prekindergarten and kindergarten children designed to provide data predictive of children's school achievement. A total of 109 boys and girls were given the Complete Assessment Battery, Metropolitan Readiness Tests (MRT), and the California Short-Form Test of Mental Maturity at the end of kindergarten or in the middle of the first primary year. Test scores were compared with the same children's scores on the Stanford Achievement Test given at the end of the first primary year. Of the 24 factors used in prediction, exclusive of age and sex, the total raw score of the MRT (which can be given to groups of eight or ten children) administered at the end of kindergarten appeared to be the most practical predictor of performance as measured by the Stanford Achievement Test at the end of the first primary year. Only slight improvement in prediction was gained by using combinations of tests in the Complete Assessment Battery, with MRT subtests. (Author/NH)

PREDICTION OF ACHIEVEMENT IN THE FIRST PRIMARY YEAR

Study Number One

OVERVIEW

A four year U.S.O.E. prekindergarten-kindergarten research study, 1966-1970, has provided data which might be predictive of subsequent achievement of children. In this investigation, test scores of the Complete Assessment Battery, the Metropolitan Readiness Tests, and the California Short-Form Test of Mental Maturity, administered at the end of kindergarten or in the middle of the first primary year, were compared with scores of the same children on the Stanford Achievement Test at the end of the first primary year.

Methods. Test scores of 51 boys and 58 girls were combined in this study as the computed age and sex differences in achievement were not statistically significant. Data from tests having total scores derived from subtest scores were treated separately from those yielding only a single score in order to avoid using whole and part test scores in the same statistical analysis.

Results. Of the 24 factors used in prediction, exclusive of age and sex, the Metropolitan Readiness Tests total raw score appeared to be the most useful measure of success on the six Stanford Achievement Test subtests. However, six tests in the Complete Assessment Battery, used with five of the six Metropolitan Readiness Tests subtests, yielded slightly better predictions of achievement in Stanford Achievement Test subtests.

Conclusions. Performance on the subtests of the Stanford Achievement Test can be effectively predicted from the Metropolitan Readiness Tests total raw score. Only slight improvement in prediction was gained by using combinations of subtests of the Metropolitan Readiness Tests with tests comprising the Complete Assessment Battery. In view of the fact that the Readiness test can be given to groups of eight to ten children while the assessment tests must be given individually, the total raw score of the Metropolitan Readiness Tests administered at the end of kindergarten appeared to be the most practical predictor of performance as measured by the Stanford Achievement Test at the end of the first primary year.

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PREDICTION OF ACHIEVEMENT
IN THE FIRST PRIMARY YEAR

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The U.S.O.E. prekindergarten-kindergarten research studies, 1966-1970 (1, 2, 3), have provided a variety of data useful in follow-up investigations during the current and in subsequent years. The present study reports the relationship of achievement as measured by the Stanford Achievement Test at the end of the first primary year (April 1969) to measures administered from four to 11 months earlier. These previous measures were 1. the Complete Test Battery (May 1968), 2. the Metropolitan Readiness Tests (May 1968), and 3. the California Test of Mental Maturity (January 1969).

METHODS

Data on experimental and control children were combined in this study because the objective was prediction at a specific time rather than the effect of previous education. Since preliminary analyses showed no significant sex (51 boys and 58 girls) or age differences in achievement at the end of the first primary year, the sexes and children of varying ages were combined for the remainder of the study (Appendix B).

Analyses of Data.

Two types of analyses of the prediction tests were used, one for tests having total scores derived from subtest scores (e.g. the Metropolitan Readiness Tests total score), the other for tests providing only a single score (e.g. Development Test of Visual-Motor Integration (VMI) or separate subtest scores of Metropolitan Readiness Tests). In each analysis, predictions were made separately for each Stanford Achievement Test subtest.

Tests used in the prediction of achievement and their abbreviations are listed in Table 1.

Table 1. Prediction Instruments

TESTS HAVING TOTAL SCORES DERIVED FROM SUBTEST SCORES
Metropolitan Readiness Tests, total raw score (M-TOT) (4)
California Short-Form Test of Mental Maturity (5)
Language IQ (L-IQ)
Non-language IQ (NL-IQ)
Total IQ (T-IQ)
Illinois Test of Psycholinguistic Abilities, Language Quotient (ITPA-LQ) (6)

Table 1. (continued)

TESTS HAVING ONLY SINGLE SCORES

Test	Major Area Measured
Metropolitan Readiness Tests, subtest raw scores (4)	
Word Meaning (M-WM)	
Listening (M-LIST)	
Matching (M-MATCH)	Readiness
Alphabet (M-ALPH)	
Numbers (M-NOS)	
Copying (M-COPY)	
Complete Assessment Battery	
Illinois Test of Psycholinguistic Abilities, subtest raw scores (6)	
Auditory Decoding (ITPA-1)	Auditory Reception
Visual Decoding (ITPA-2)	Visual Reception
Auditory-Vocal Association (ITPA-3)	Auditory Association
Visual-Motor Association (ITPA-4)	Visual Association
Vocal Encoding (ITPA-5)	Verbal Expression
Motor Encoding (ITPA-6)	Manual Expression
Auditory-Vocal Automatic (ITPA-7)	Grammatic Expression
Auditory-Vocal Sequencing (ITPA-8)	Auditory Sequential Memory
Visual-Motor Sequencing (ITPA-9)	Visual Sequential Memory
Peabody Picture Vocabulary Test, IQ (PPVT-IQ) (7)	Vocabulary
Three-Dimensional Auditory Discrimination (3-D) (Devised locally)	Auditory Discrimination
Developmental Test of Visual-Motor Integration (VMI) (8)	Visual-Motor Integration
Gross Motor Observations (GMO) (Devised Locally)	Motor Coordination

Subtests of Achievement are listed in Table 2.

Table 2. Achievement Subtests

Stanford Achievement Test, grade equivalents (9)
Word Reading (S-WR)
Paragraph Meaning (S-PM)
Vocabulary (S-VOC)
Spelling (S-SPELL)
Word Study Skills (S-WSS)
Arithmetic (S-ARITH)

Tests Having Total Scores Derived from Subtest Scores.

To predict achievement from tests in which total scores are derived from their subtest scores, correlation analyses were computed for the total score of each prediction test with each subtest score of the Stanford Achievement Test. The computations were made separately from tests having only single scores in order to avoid using both total and part scores in the same analysis (Appendix A). Interpreted, the figures mean the higher the correlation (r), the greater is the likelihood that a score on one test will predict a score on another test.

Tests Having Only Single Scores.

To predict achievement from tests yielding only a single score, unit-weight step linear multiple regression analyses were computed. These analyses relate prediction tests or a series of prediction tests having only single scores to obtained scores on each achievement subtest (Appendix A). Again, the higher the correlation, the greater is the predictive value of the test or series of tests.

RESULTS

A substantial number of the tests or subtests currently administered locally at the end of kindergarten and in the middle of the first primary year proved to be useful in predicting achievement in one or several skill areas measured by the Stanford Achievement Test at the end of the first primary year. Table 3 details the results in the present study.

Table 3. Highest Significant Correlations between Prediction Tests and Stanford Achievement Test Subtests

STANFORD ACHIEVEMENT	TOTAL TEST SCORES					MEASURES HAVING SINGLE SCORES										
	MET TOT	CTMM			ITPA LQ	M-ALPH	PPVT IQ	M-NOS	ITPA 3	ITPA 9	ITPA 8	VMI	ITPA 7	M-LIST	M-COPY	M-MATCH
		T-IQ	NL-IQ	L-IQ												
S-PM	.54	.52	.53	.45	.44	(1)[a] .47					(2) .55	(3) .57		(4) .59		(5)[b] .60
S-ARITH	.64	.52	.49	.48	.56			(1) .62	(4) .70			(2) .66	(3) .68			
S-WR	.50	.34	.36	.29	.28	(1) .47			(2) .51	(3) .54		(4) .56				
S-SPELL	.54	.43	.42	.40	.28	(1) .49						(2) .58				(3) .60
S-WSS	.52	.45	.41	.43	.41	(2) .49			(1) .42						(3) .52	
S-VOC	.56	.48	.40	.45	.50	(5) .67	(1) .55	(2) .61	(3) .64			(4) .66				

[a]The numbers in parentheses ( ) refer to the order and number of measures having single scores required to obtain each correlation coefficient. The correlation value numbered (1) may be used alone but all subsequent correlation coefficients are dependent upon those which precede it.

[b]The last numbered correlation coefficient indicates the highest value obtained.

Thirteen of the 21 measures administered at the end of kindergarten were identified as predictors on one or more subtests of the Stanford Achievement Test. These measures were: The Illinois Test of Psycholinguistic Abilities-Language Quotient (ITPA-LQ) and subtests Auditory-Vocal Association (ITPA-3), Auditory-Vocal Automatic (ITPA-7), Auditory-Vocal Sequencing (ITPA-8), Visual-Motor Sequencing (ITPA-9); the Metropolitan Readiness Tests-total raw score (M-TOT) and subtests Listening (M-LIST), Matching (M-MATCH), Alphabet (M-ALPH), Numbers (M-NOS), Copying (M-COPY); the Peabody Picture Vocabulary Test (PPVT-IQ); and the test of Visual-Motor Integration (VMI).

All three measures administered in the middle of the first primary year also were identified as predictors of performance on the Stanford Achievement Test. These measures were the California Short-Form Test of Mental Maturity-language intelligence quotient (L-IQ), non-language intelligence quotient (NL-IQ), and total intelligence quotient (T-IQ).

All five tests having total scores derived from subtest scores showed significant positive correlations ranging from $r = .28$ to $r = .64$ with the six subtests of the Stanford Achievement Test. Of these measures, the Metropolitan Readiness Tests total raw score (M-TOT) provided the highest correlations, having a range from $r = .50$ to $r = .64$. The multiple correlations derived from measures having single scores with the Stanford subtests provided a range from $r = .42$ to $r = .70$. Compared with the Metropolitan Tests total raw score, the tests having only single scores provided only slightly higher correlation coefficients.

The comparisons of significant correlation coefficients of the M-TOT with the Stanford Achievement Test and significant multiple correlation coefficients of the single score measures with the Stanford Achievement Test were the following:

Stanford Paragraph Meaning (S-PM) with M-TOT, $r = .54$.
S-PM with M-ALPH, $r = .47$; plus ITPA-8, $r = .55$; plus VMI, $r = .57$; plus M-LIST, $r = .59$; plus M-MATCH, $r = .60$.

Stanford Arithmetic (S-ARITH) with M-TOT, $r = .64$.
S-ARITH with M-NOS, $r = .62$; plus VMI, $r = .66$; plus ITPA-7, $r = .68$; plus ITPA-3, $r = .70$.

Stanford Word Reading (S-WR) with M-TOT, $r = .50$.
S-WR with M-ALPH, $r = .47$; plus ITPA-3, $r = .51$; plus ITPA-9, $r = .54$; plus VMI, $r = .56$.

Stanford Spelling (S-SPELL) with M-TOT, $r = .54$.
S-SPELL with M-ALPH, $r = .49$; plus VMI, $r = .58$; plus M-MATCH, $r = .60$.

Stanford Word Study Skills (S-WSS) with M-TOT, $r = .52$.
S-WSS with ITPA-3, $r = .42$; plus M-ALPH, $r = .49$; plus M-COPY, $r = .52$.

Stanford Vocabulary (S-VOC) with M-TOT, $r = .56$.
S-VOC with PPVT-IQ, $r = .55$; plus M-NOS, $r = .61$; plus ITPA-3, $r = .64$; plus VMI, $r = .66$; plus M-ALPH, $r = .67$.

For purposes of predicting performance on each of the six subtests of the Stanford Achievement Test, eleven single tests provided the highest correlations. These tests were: M-LIST, M-MATCH, M-ALPH, M-NOS, M-COPY, ITPA-3, ITPA-7, ITPA-8, ITPA-9, PPVT-IQ, and VMI. However, these correlations are only slightly higher than the correlations of the Metropolitan total with the Stanford subtests and include five of the six parts that makeup the Metropolitan total. Seven single tests (M-ALPH, M-NOS, M-COPY, ITPA-3, ITPA-8, PPVT, and VMI) were required to achieve correlations higher than those provided by the Metropolitan total and three of the seven tests are parts of the Metropolitan test. Since the Metropolitan Readiness Tests can be administered to small groups while the tests of the Complete Assessment Battery must be given individually, and since the single score correlations are heavily dependent on the Metropolitan parts, the slight increase in the value of the correlations does not warrant the use of the individual tests examined or the increased time required.

CONCLUSIONS

Two group tests and five individual tests, administered at the end of kindergarten or in the middle of the first primary year, provided a total of 24 test scores used to predict performance on six subtests of the Stanford Achievement Test at the end of the first primary year. Sixteen of these test scores correlated with one or more achievement subtests at a statistically significant level indicating their usefulness as predictors. Five of the 16 measures were total scores derived from subtest scores. The Metropolitan Readiness Tests total raw score provided the highest correlations of the five total score measures. Seven single score measures were required to compute higher correlations. Eleven single score measures provided the highest correlations, but the values still were only slightly higher than those provided by the Metropolitan total score.

Group measures such as the Metropolitan Readiness Tests and the California Short-Form Test of Mental Maturity generally are more economical in terms of administration time than tests which are administered individually. In this investigation, to obtain higher correlations than those provided by the Metropolitan Readiness Tests total raw score, individual tests had to be used in combination with three of the Metropolitan Readiness subtests, thus appreciably lengthening test administration time without substantially increasing the reliability of those predictions. For these reasons, the Metropolitan Readiness Tests are not only the most practical measures among those examined for determining readiness for the first primary school year, but also the total score is the most practical predictor of performance at the end of that year as measured by the Stanford Achievement Test.

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APPENDIX A

CORRELATION AND MULTIPLE CORRELATION
applied to the
UNIT-WEIGHT STEP LINEAR MULTIPLE REGRESSION ANALYSIS

Correlation may be defined as the tendency of certain paired measures to vary concomitantly, so that knowledge of the value of one gives information as to the mean value of all measures paired with that measure. Multiple correlation is the extension of the correlation method to more than two measures. The degree of relationship between two measures or of one measure with two or more measures, expressed numerically, is called correlation coefficient, or correlation, and is indicated by "r".

Table 1A gives examples of both correlation and multiple correlation in predicting three Measures of Performance (A, B, C). Assume that Test W (the total score of which is derived from Tests 1-5) requires 60 minutes to administer while Tests 1, 2, 3, 4, 5 require only 12 minutes each. If the multiple correlations of Measures A, B, or C with one or several of the short Tests 1 to 5, were equal to or greater than the correlations of Measures A, B, or C with the longer Test W, thereby indicating a closer relationship, then the advantage of using the shorter tests is doubly apparent. However, if the multiple correlations were lower, a judgment of the relative importance of time and the degree of desired relationship would be required.

In the following table, Test W with Measures A, B, and C showed correlations of r = .50, r = .60, and r = .54 respectively. Equal or higher correlation coefficients were found by multiple correlations using the shorter tests.

Measure A with Test W gave r = .50. Measure A with Test 1 alone gave r = .47, but adding Test 4 to Test 1 gave r = .55. By adding Test 5 to Tests 1 and 4 the correlation was increased to r = .57. Note that Test 1 alone gave a lower correlation than Test W, but Tests 1 and 4 increased the correlation .08 above Test 1 alone and .05 above Test W. All three Tests (1, 4, and 5) must be included to give a correlation of r = .57.

Measure B with Test W gave r = .60. Measure B with Test 2 gave r = .66 or .06 higher. In this instance, a higher correlation was obtained with a 12 minute test than with a 60 minute test. By adding Test 4 and Test 3 to Test 2 in that order, the multiple correlation became r = .70, an increase of .10 in 36 minutes of testing time as compared with Test W which required 60 minutes of testing time.

Measure C with Test W gave r = .54; with Test 1 also r = .54. A reduction of testing time from 60 minutes to 12 minutes did not decrease the value of the correlation. The inclusion of any additional tests with Test 1 increased the r less than .01, an amount too small to justify further computation.

Table 1A. Highest Significant Correlations between Prediction Tests and Test Areas to be Predicted

MEASURE OF PERFORMANCE	Test W	PREDICTION TESTS				
		Test 1	Test 2	Test 3	Test 4	Test 5
Measure A	.50	(1)[a] .47			(2) .55	(3)[b] .57
Measure B	.60		(1) .66	(3) .70	(2) .68	
Measure C	.54	(1)[ab] .54				

[a]The numbers in parentheses ( ) refer to the order and number of measures having single scores required to obtain each correlation coefficient. The correlation value numbered (1) may be used alone but all subsequent correlation coefficients are dependent upon those which precede it.

[b]The last numbered correlation coefficient indicates the highest value obtained.

APPENDIX B

Correlations of Sex and Age with the Stanford Achievement Test

Test	Correlation	Significance	Correlation	Significance
	SEX		AGE	
S-WR	.016	ns	.138	ns
S-PM	-.041[a]	ns	.074	ns
S-VOC	.126	ns	.135	ns
S-SPELL	-.125	ns	.132	ns
S-WSS	-.047	ns	.059	ns
S-ARITH	.078	ns	.181	ns

[a]A negative sign indicates data favoring girls.

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